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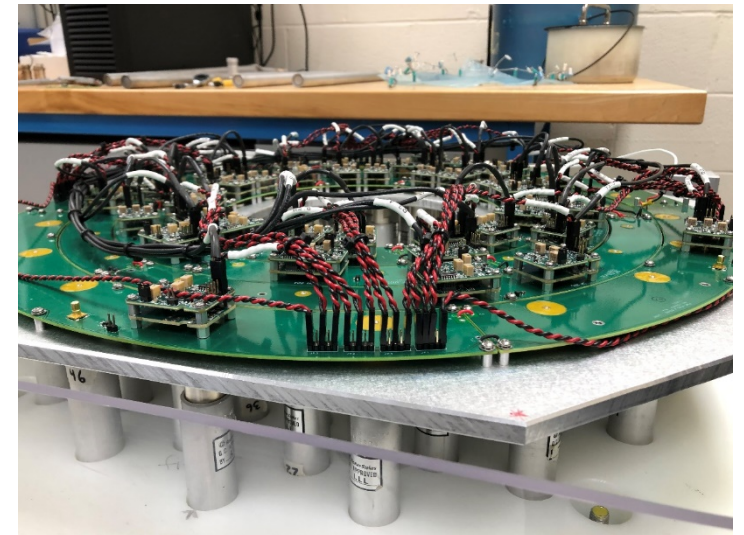
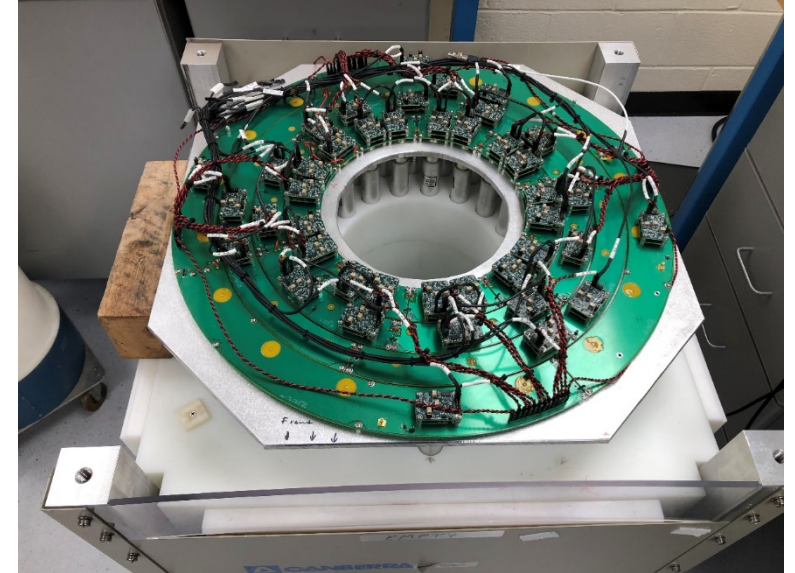
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PSMC Upgrade Development Documentation and Functional Testing

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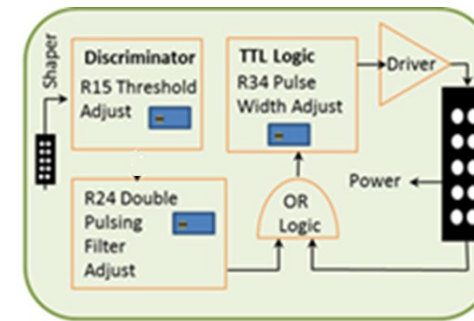
Wiring, Calibration Procedure, and Functional Verification

- Prototype assembly, power-up, signal checks and troubleshooting
 - Correct operation of each KM200 was verified with charge injector prior to installation in counter.
 - Wire harnesses were assembled and connected to each KM200 amplifier according to the wiring diagram.
 - Power converters from 12V to 5V were used to supply 5V power to the distribution busses.
 - Signal cables were connected to the derandomizer board and List-Mode module connectors.
 - Power and high voltage were applied to the prototype junction box and electronics.
 - Issues with high voltage (HV) discharges were resolved in the prototype device. New HV distribution and mounting boards were designed and ordered.
 - Analog signal integrity was checked by measuring the noise and signal output from the KM200s' analog channels. Some issues were found and resolved.
 - Issue with power supply interference was resolved by proper grounding.
 - Wrong connections in the distribution boards were found and corrected in the prototype and in the next design.
 - Logic pulse output signals were checked.
 - Optimized mounting strategy was developed and junction box redesign updated accordingly.



Wiring, Calibration Procedure, and Functional Verification

- KM200 initial adjustment and list mode connection
 - Values for detection threshold, double pulsing filter, and logic pulse width were set prior to installation.
 - The initial threshold value is a best guess in preparation for gain matching procedure. It is set by turning potentiometer R15 and measuring the voltage on J4-Pin1. The initial threshold was set to 180mV.
 - The Double Pulsing Filter (DPF) was set to its maximum value by turning potentiometer R24 and observing the voltage on J4-Pin2. The DPF was set to 5V which is its maximum value corresponding to a disabled DPF. The DPF needs to be disabled because the shaper of the KM200 for PSMC is designed such that no double pulsing occurs in normal operation.
 - The TTL logic pulse widths were set to their minimum values (~50ns) in order to enable daisy-chaining of some KM200s. This is done by turning R34 and observing the TTL pulse duration.
 - ALMM and PTR32 list mode modules were connected to signals from the KM200s as shown in the table on the next page .



Wiring, Calibration Procedure, and Functional Verification

Table of KM200 connections to the two list mode modules (ALMM and PTR32). Both list modules have 32 channels that can individually record time-stamped pulse train data. 27 of the 32 channels are used but the PSMC.

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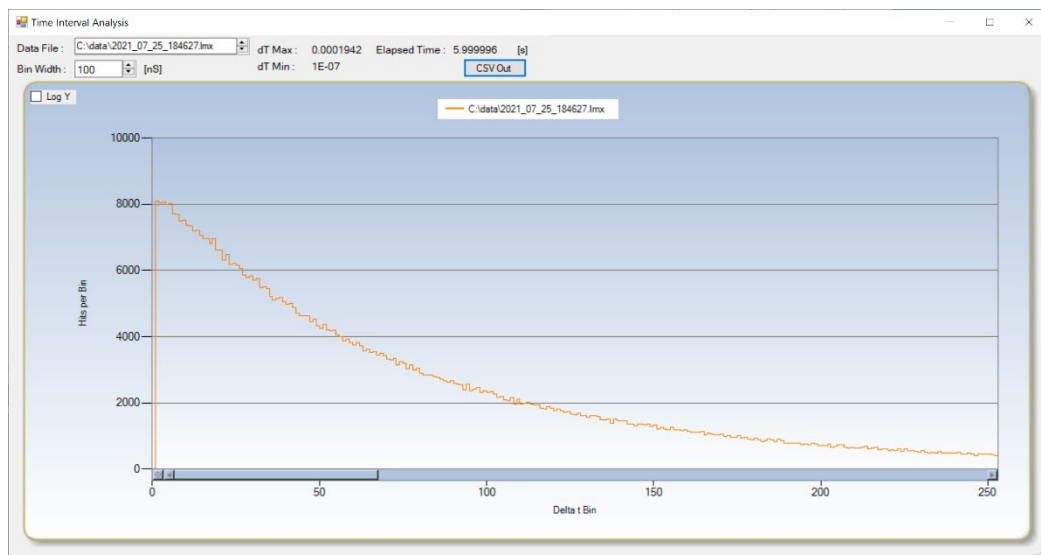
Wiring, Calibration Procedure, and Functional Verification

- Calibration and functional verification.

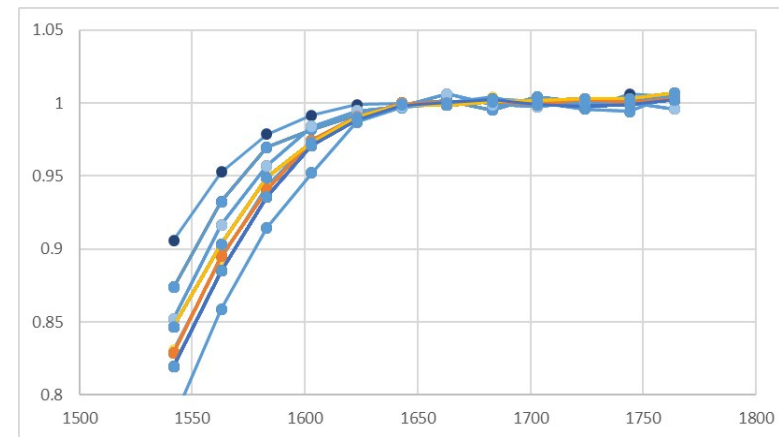
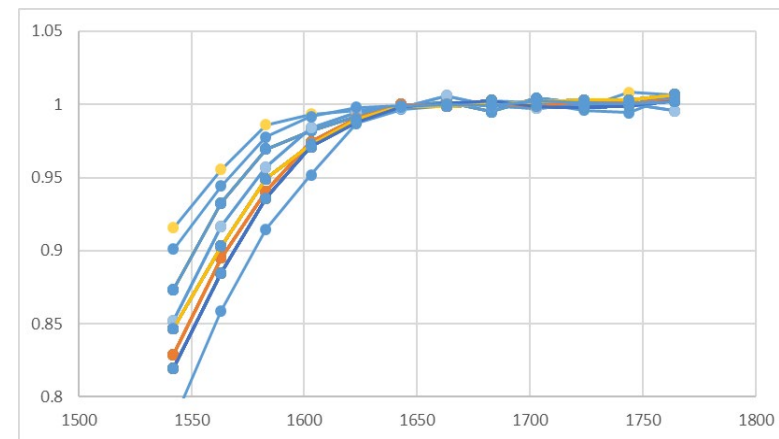
- Calibration of a single channel:

- A High Voltage Plateau counting characteristics were taken with different threshold values. The threshold value is set by turning potentiometer R15 and measuring the voltage on J4-Pin1.
 - The best threshold value is chosen such that the knee of the plateau is about 40V to 60V below the operating high voltage (usually 1680V). The chosen threshold value was 220mV.
 - The chosen threshold value was (220mV) replicated in all KM200s.
 - Plateau characteristics for all 27 channels were taken to verify that the 1680V operating point is close 40V to 60V above the knee. The normalized plateaus are shown on the two figures on the right.

- The functional verification consists of verifying that the calibration (a.k.a. gain matching) is accurate and that there is no double pulsing or signal cross talk and interference. The calibration is shown to be satisfactory from the plateau plots on the right. The absence of double pulsing and cross talk can be seen in the time-interval diagram below. Both phenomena are manifested by spikes in the time interval distribution around $1\mu\text{s}$ to $5\mu\text{s}$. No such spike is present.

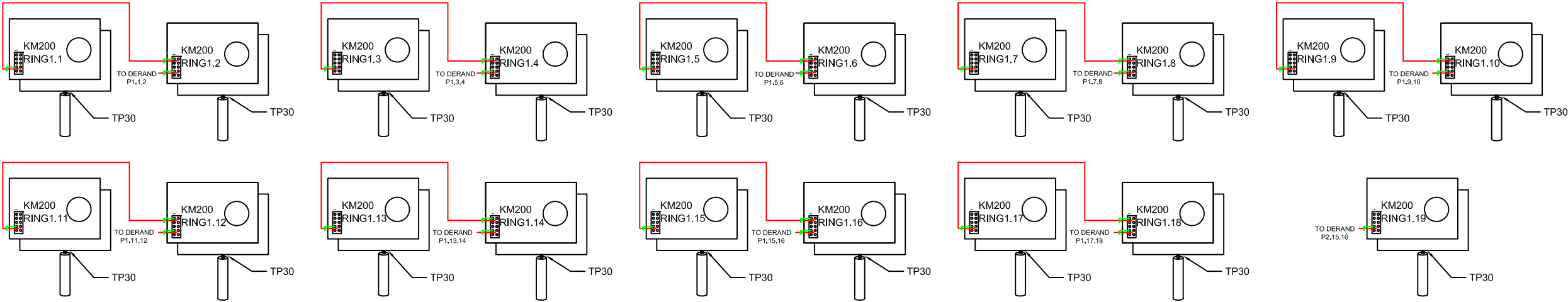


Time interval distribution of all channels in the PSMC produced by the ALMM list mode device. The beginning of the distribution (around $1\mu\text{s}$ to $5\mu\text{s}$) has no abnormal features such as sharp peaks, which indicates that double pulsing and cross talk between amplifiers is not present.

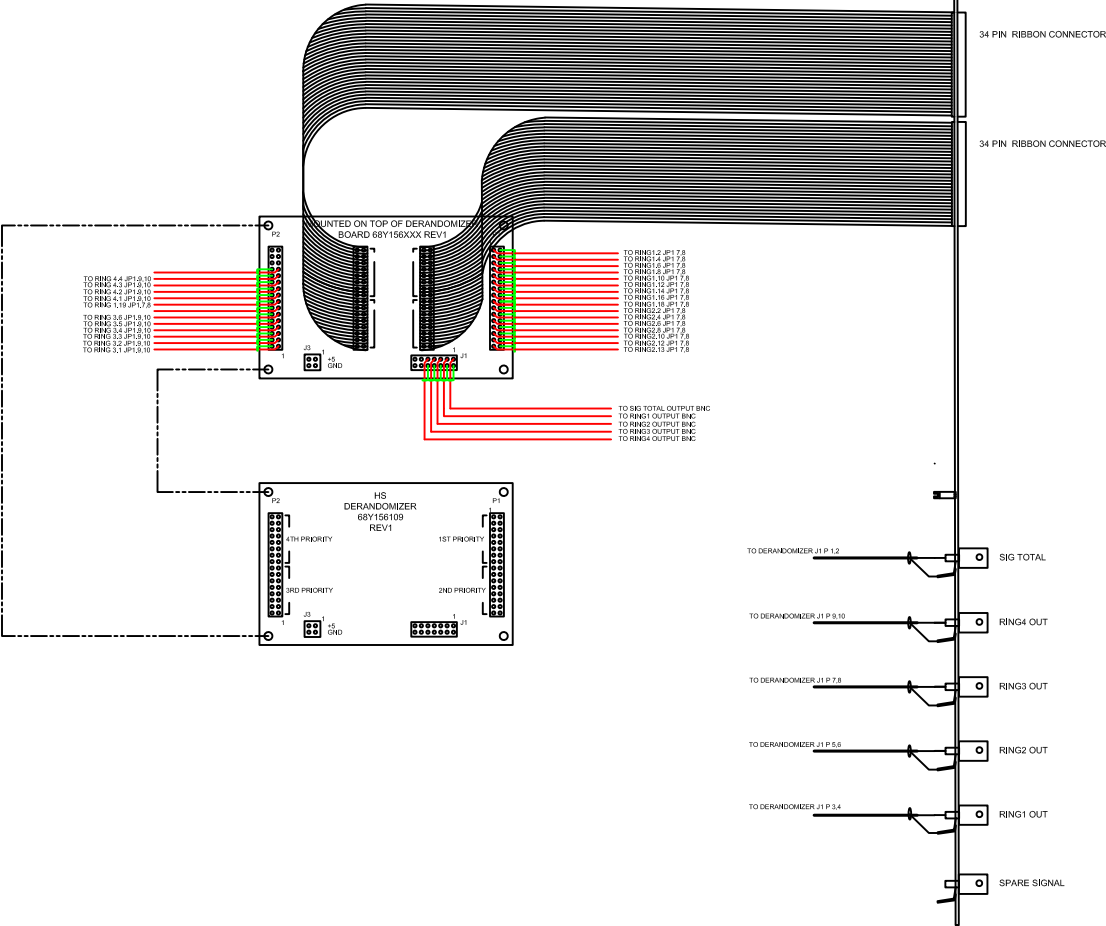
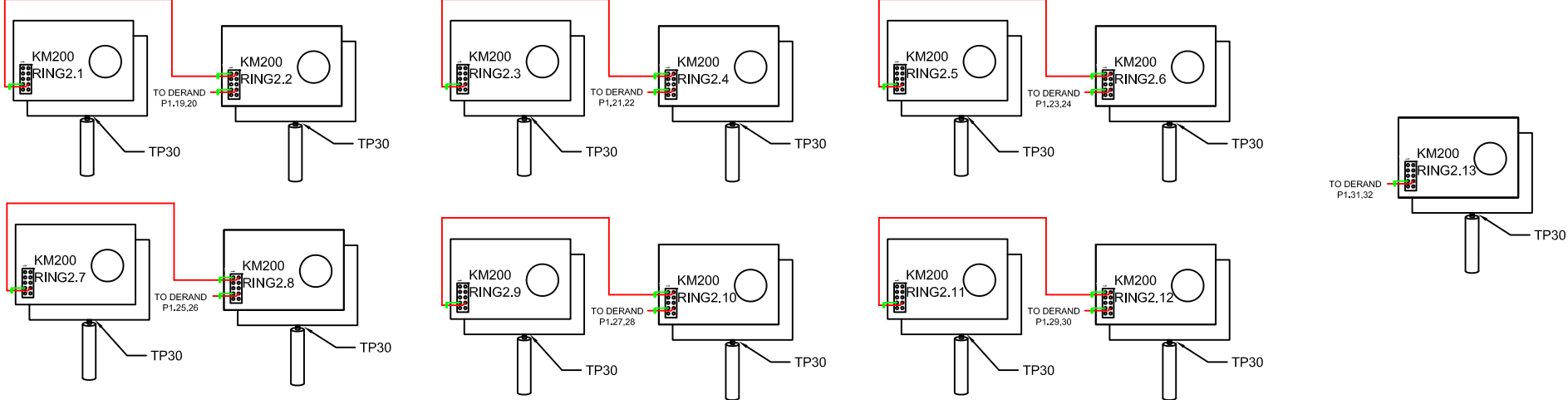


Normalized plateau counting characteristics for all PSMC channels produced by the ALMM list mode device.

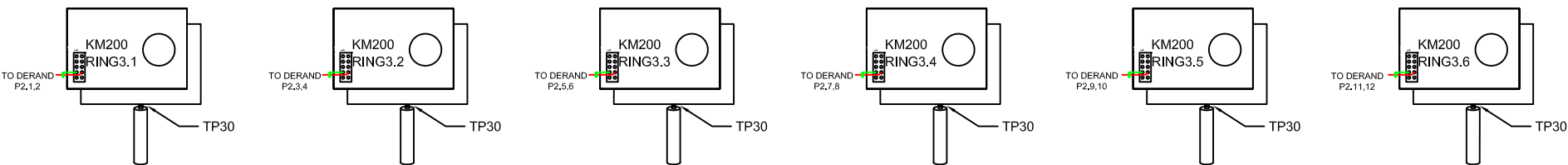
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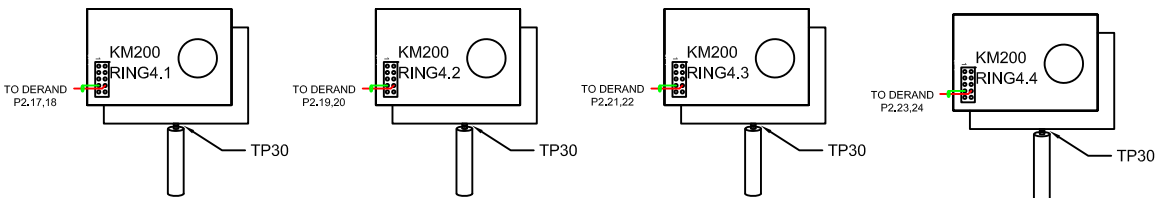
RING 2



RING 3

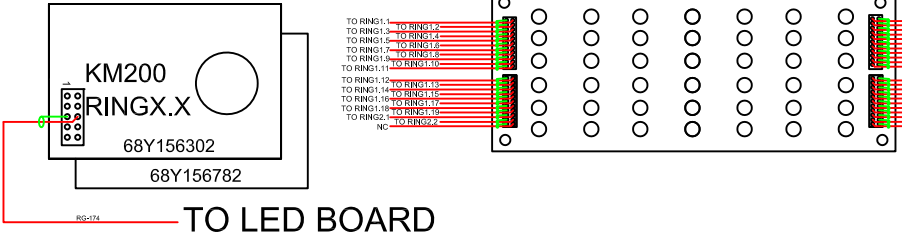


RING 4

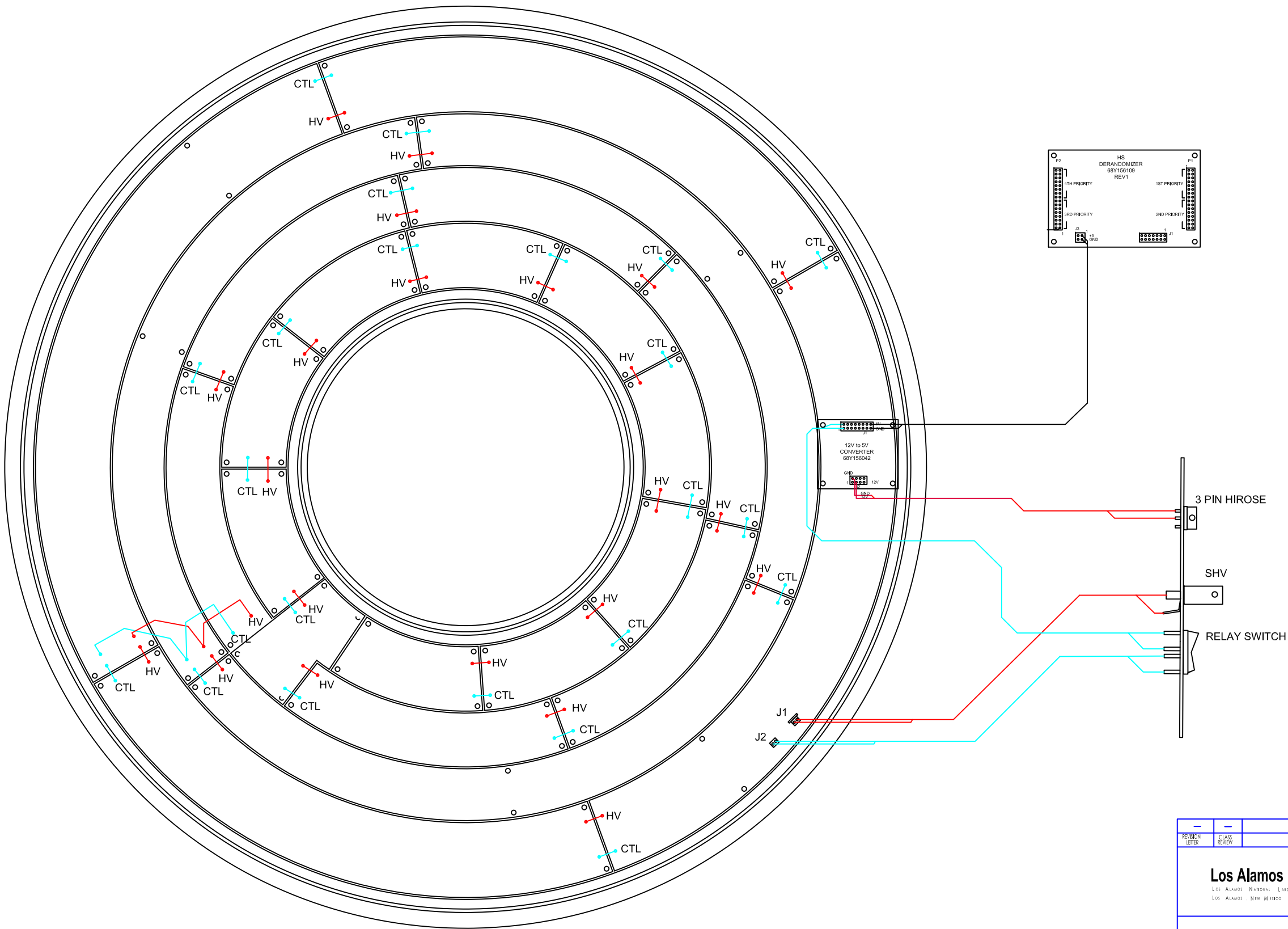


LED WIRING

*TYPICAL ON ALL KM200 BOARDS

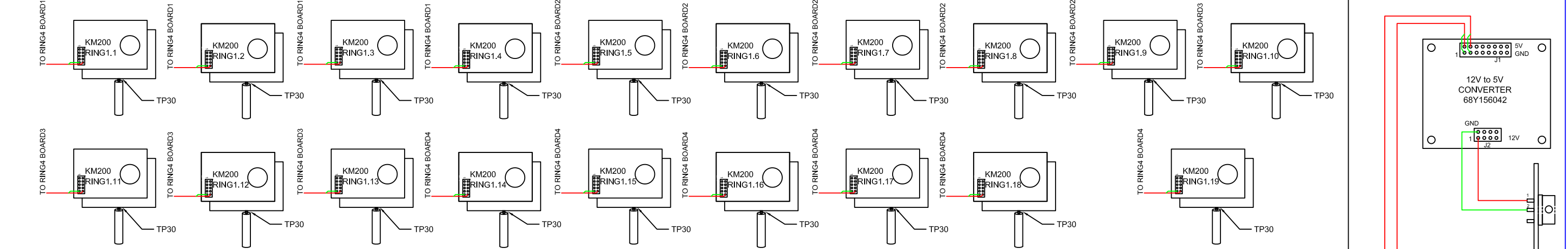


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0.0X ±				0.00X ±		.005		FINISH ±		MILL			
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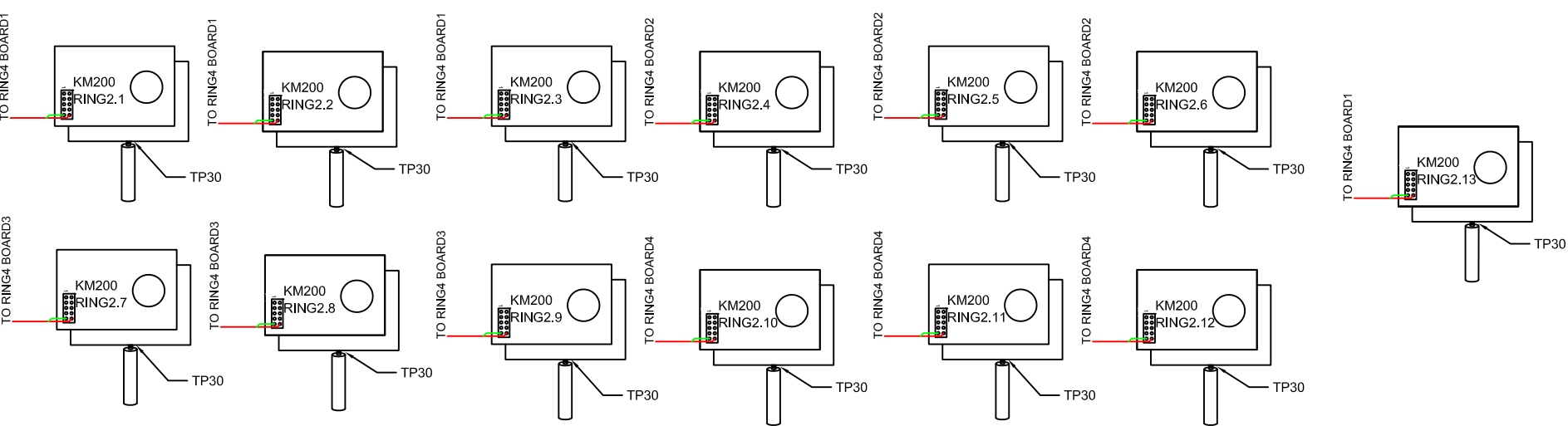


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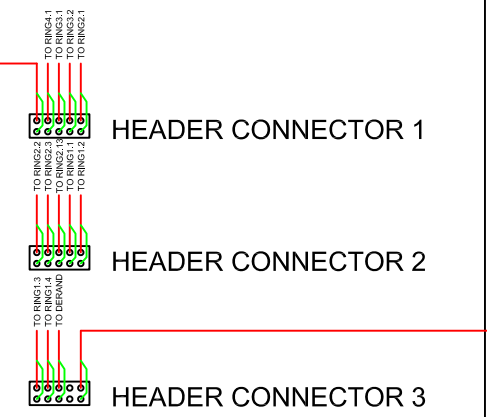
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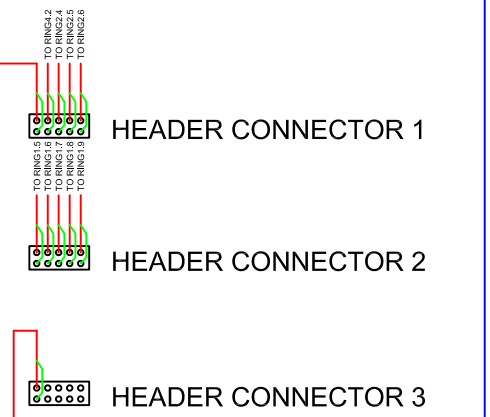
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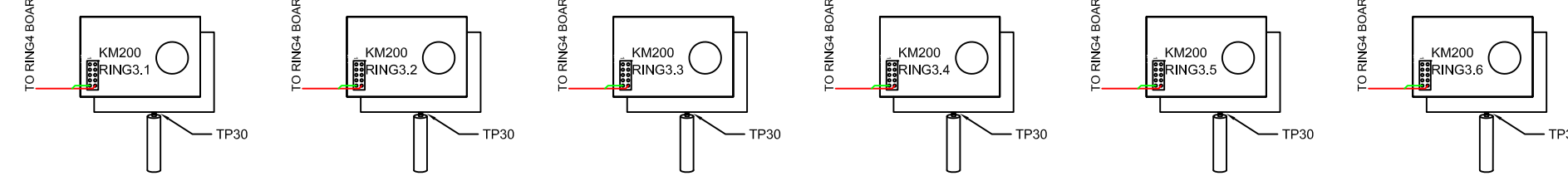
RING 4 BOARD 1



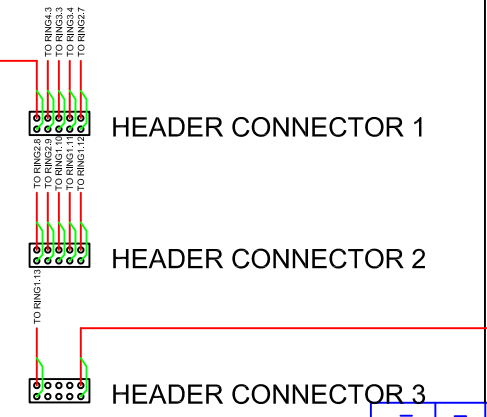
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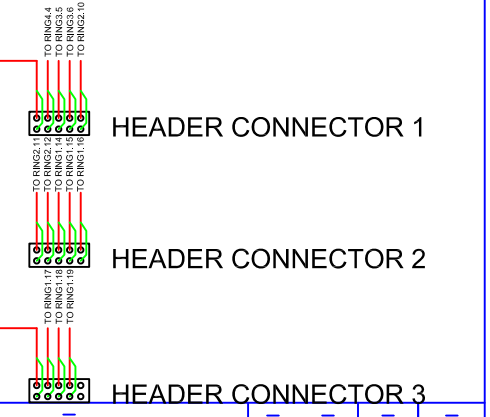
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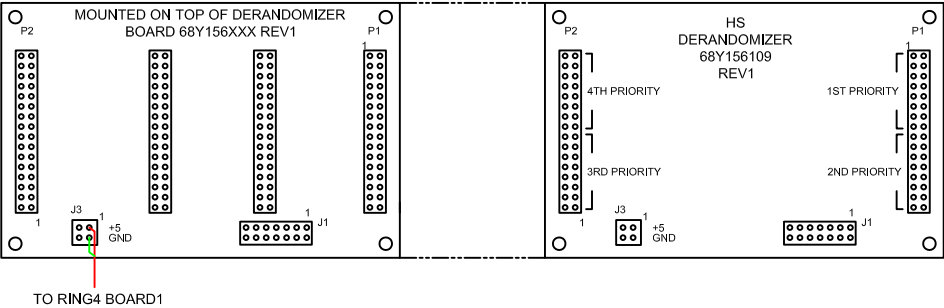
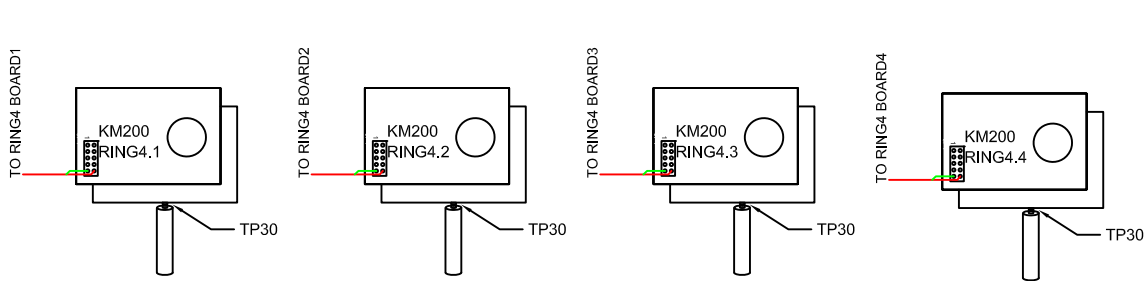
RING 4 BOARD 3



RING 4 BOARD 4

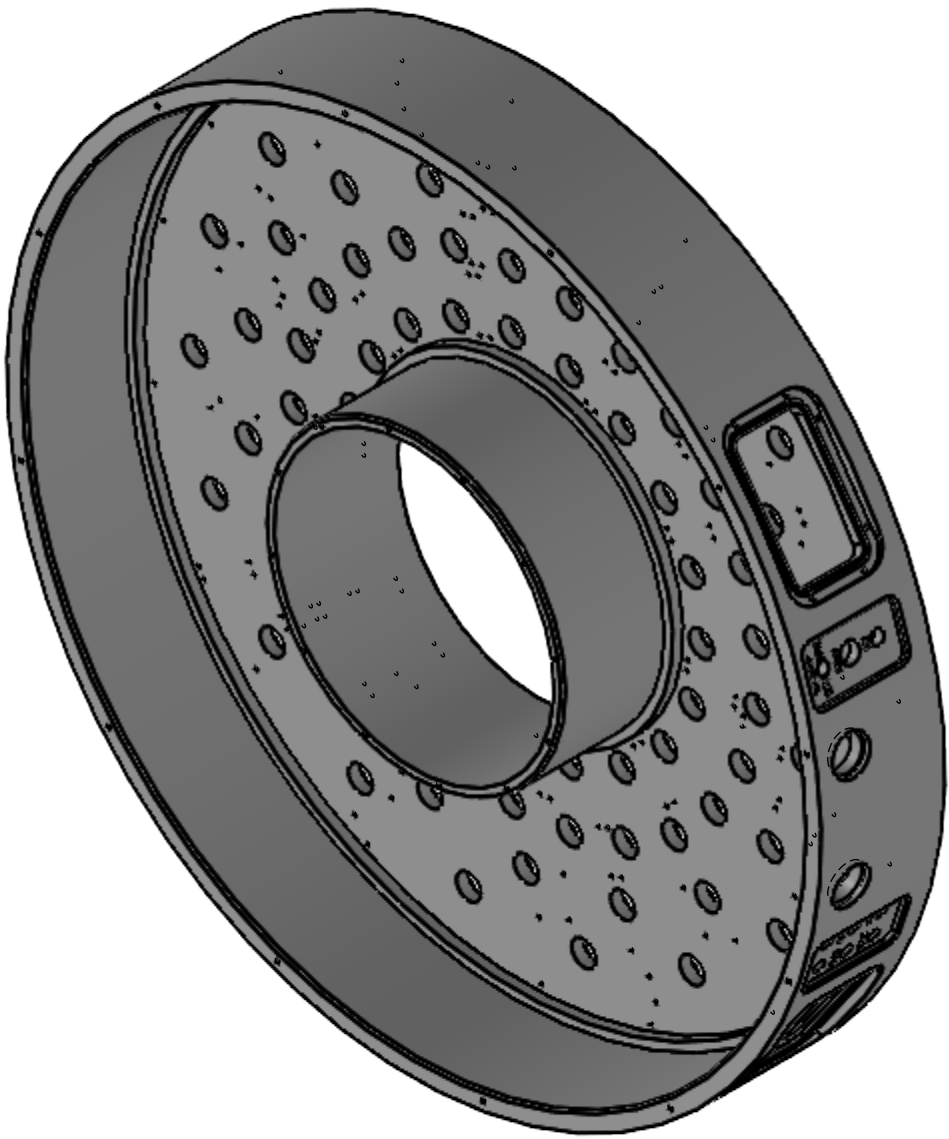
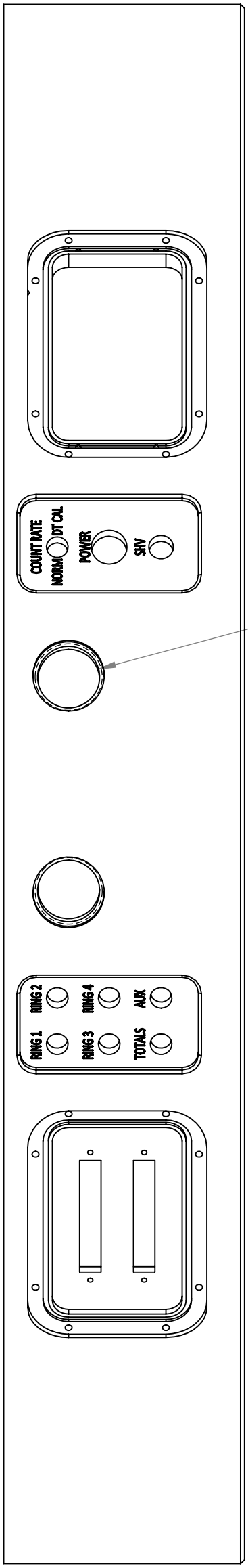
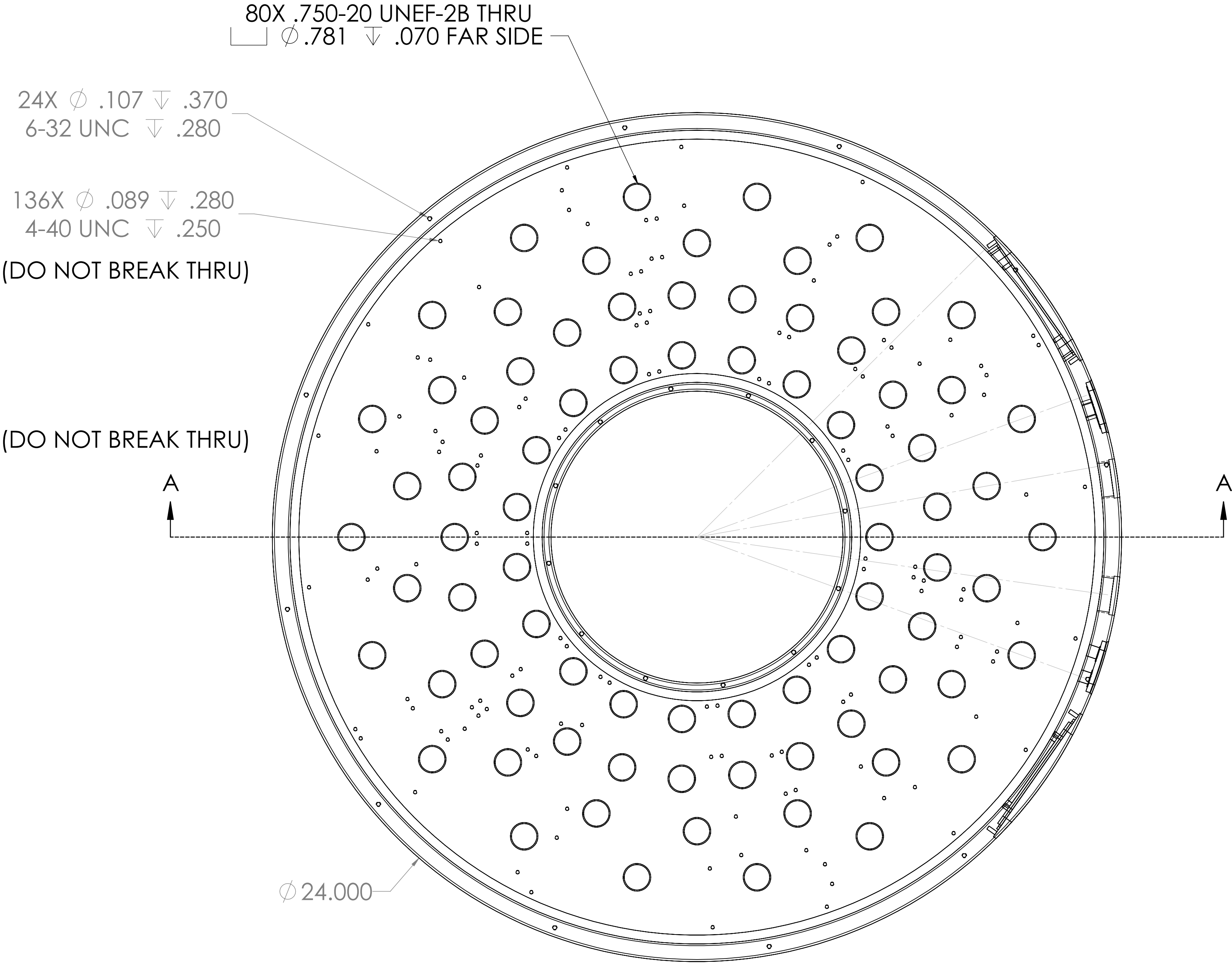


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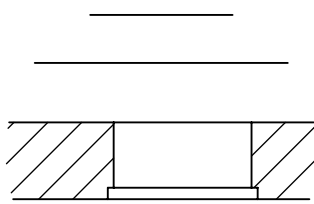
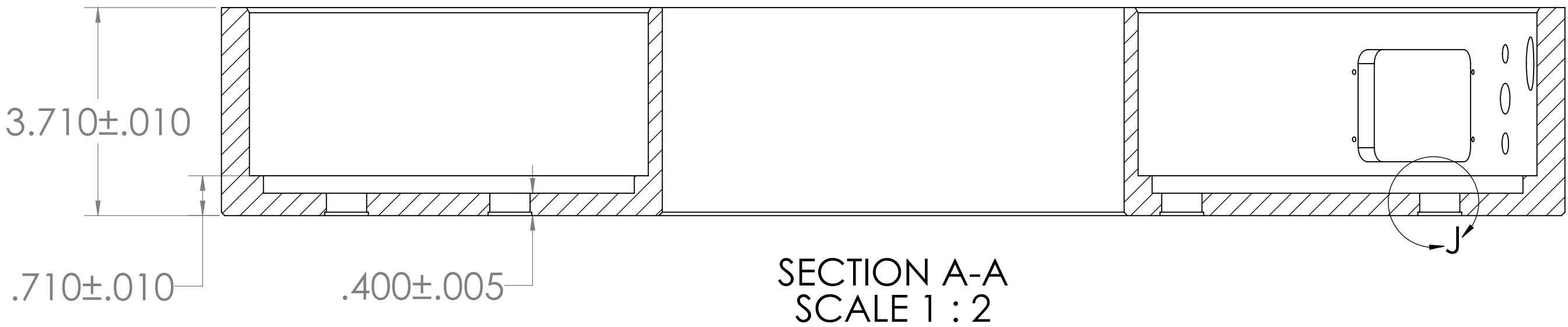


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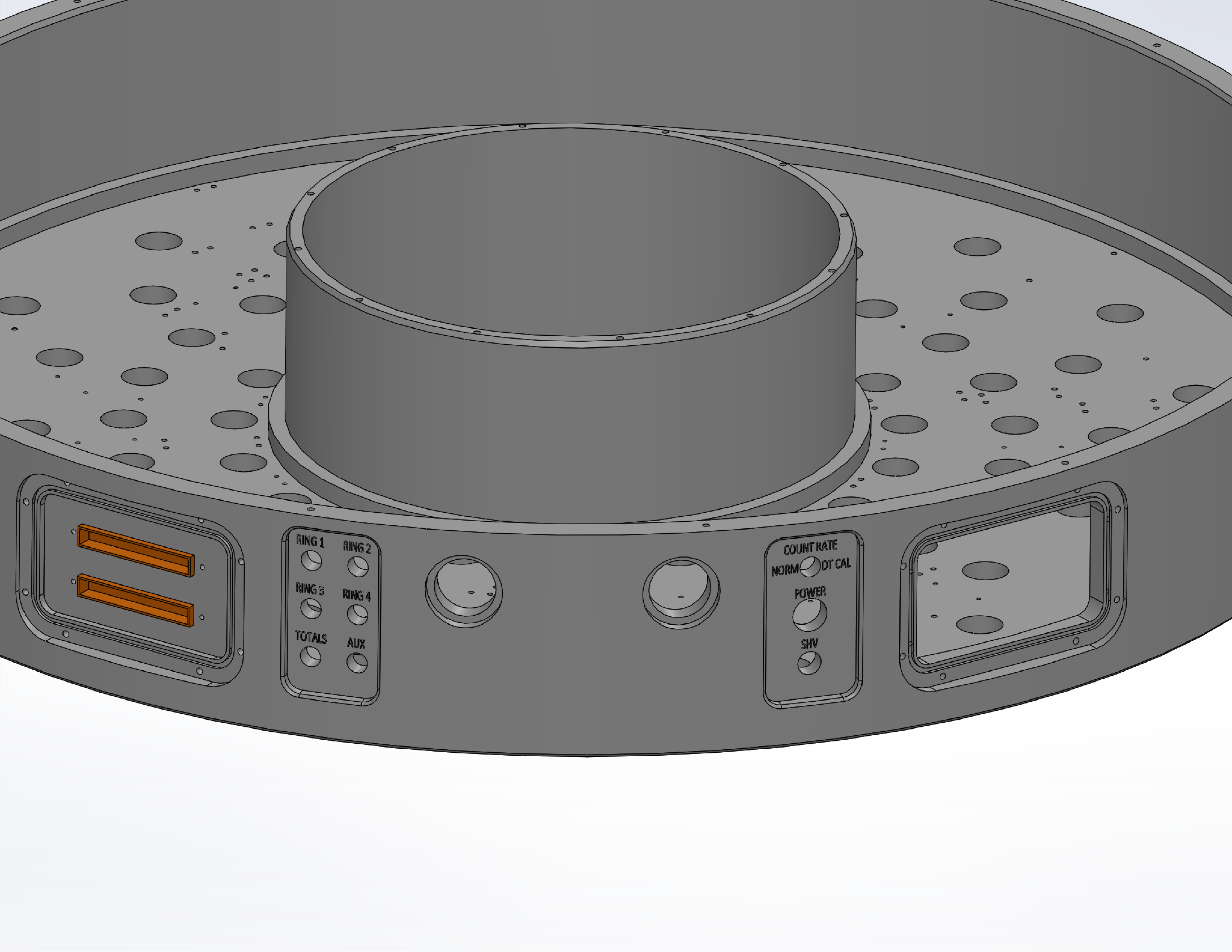
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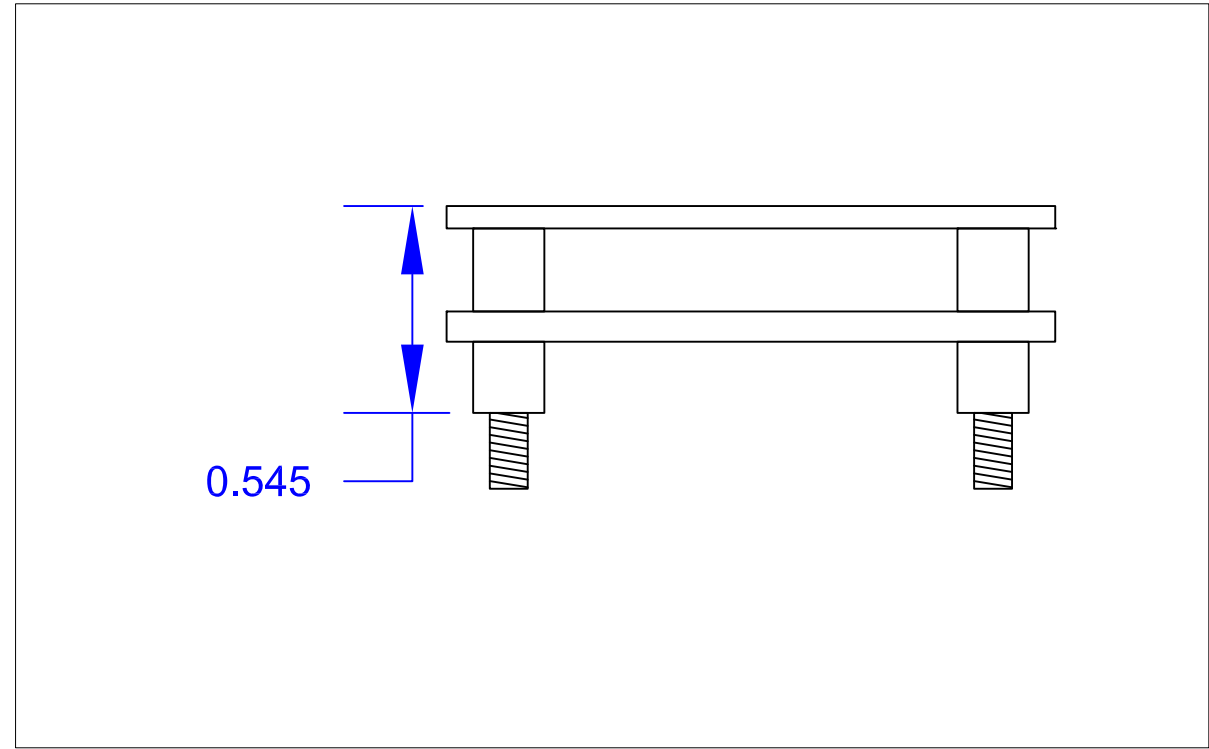
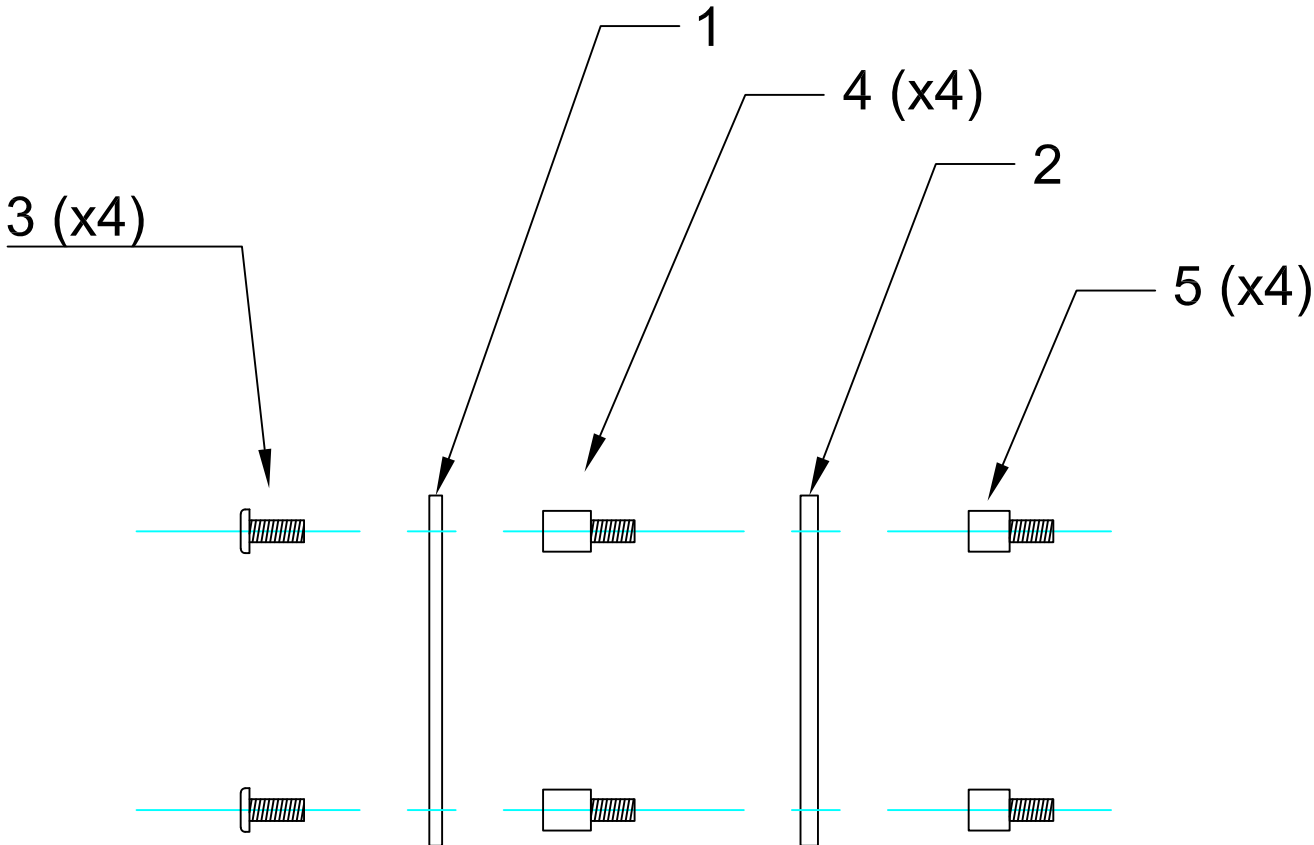


DETAIL J
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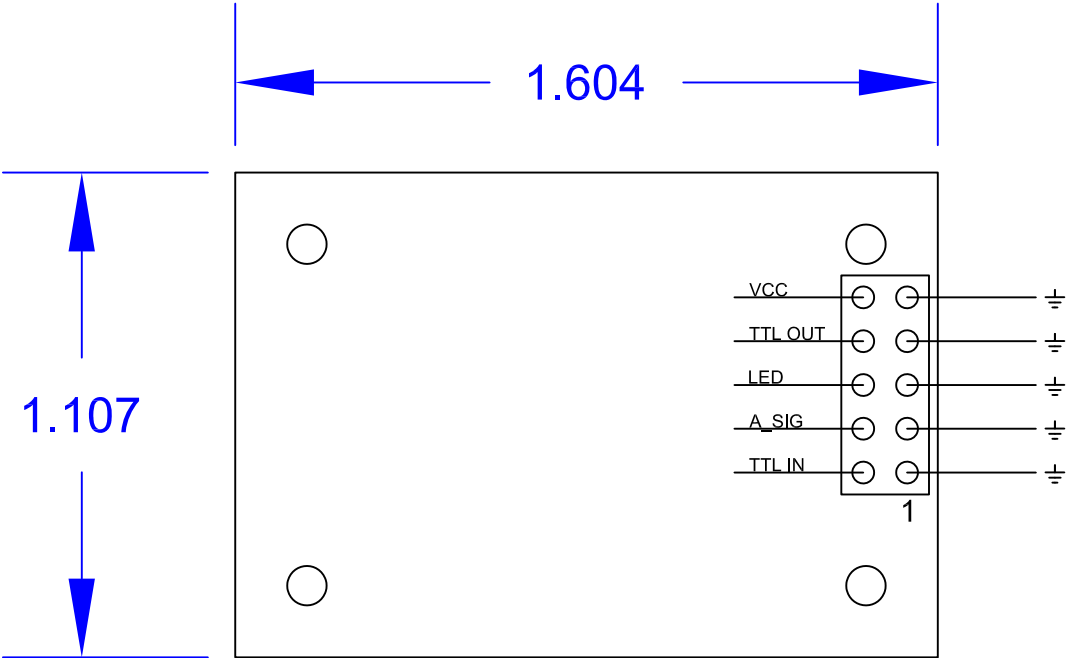
- GENERAL NOTES: (UNLESS OTHERWISE NOTED)
1. ALL DIMENSIONS IN mm/INCHES.
 2. BREAK ALL SHARP EDGES.
 3. CSK 82° ALL TAPPED HOLES TO MAJOR DIAMETER.
 4. CSK 82° x .030 DEEP ALL DRILLED HOLES.
 5. DIMENSIONING & POSITIONAL TOLERANCING PER ASME Y14.5M-1994.
 6. WELDING SYMBOLS PER ANSI/AWS A2.4-86.
 7. SURFACE TEXTURE PER ANSI B46.1-1978.

ORIGINAL ISSUE							
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0.X= ± _____				0.XXX= ± .005		FINISH= _____	
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PROJ. ENGR.							
APPROVED							
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Discriminator Board

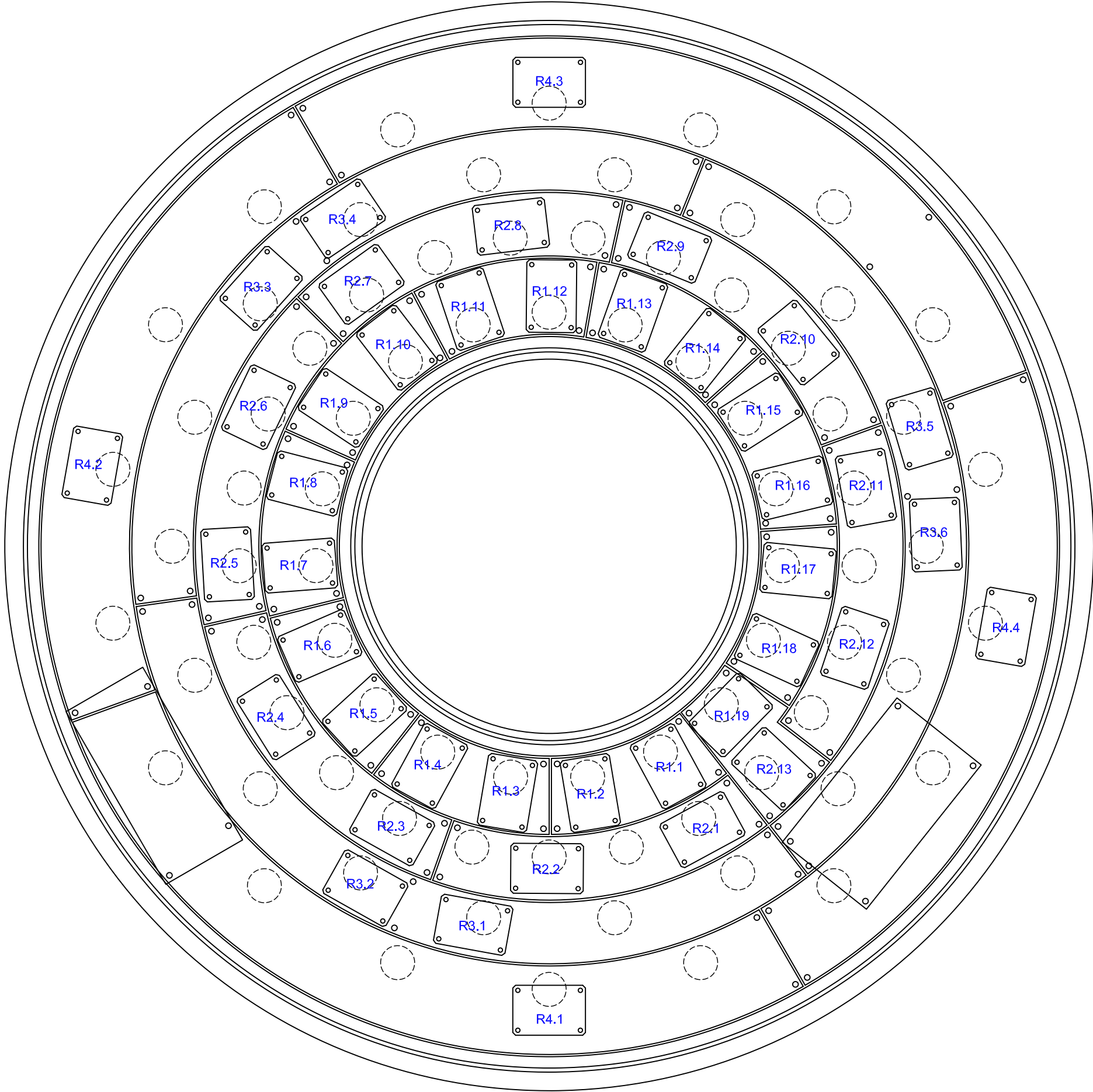


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LOS ALAMOS, NEW MEXICO 87545			UNCLASSIFIED			
KM200 in PSMC Assembly			UNCLASSIFIED			
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CHECKED				.005 ±		
PROJ. ENGR.	NA	NA	NA	.005 ±		
APPROVED	NA	NA	NA	.005 ±		
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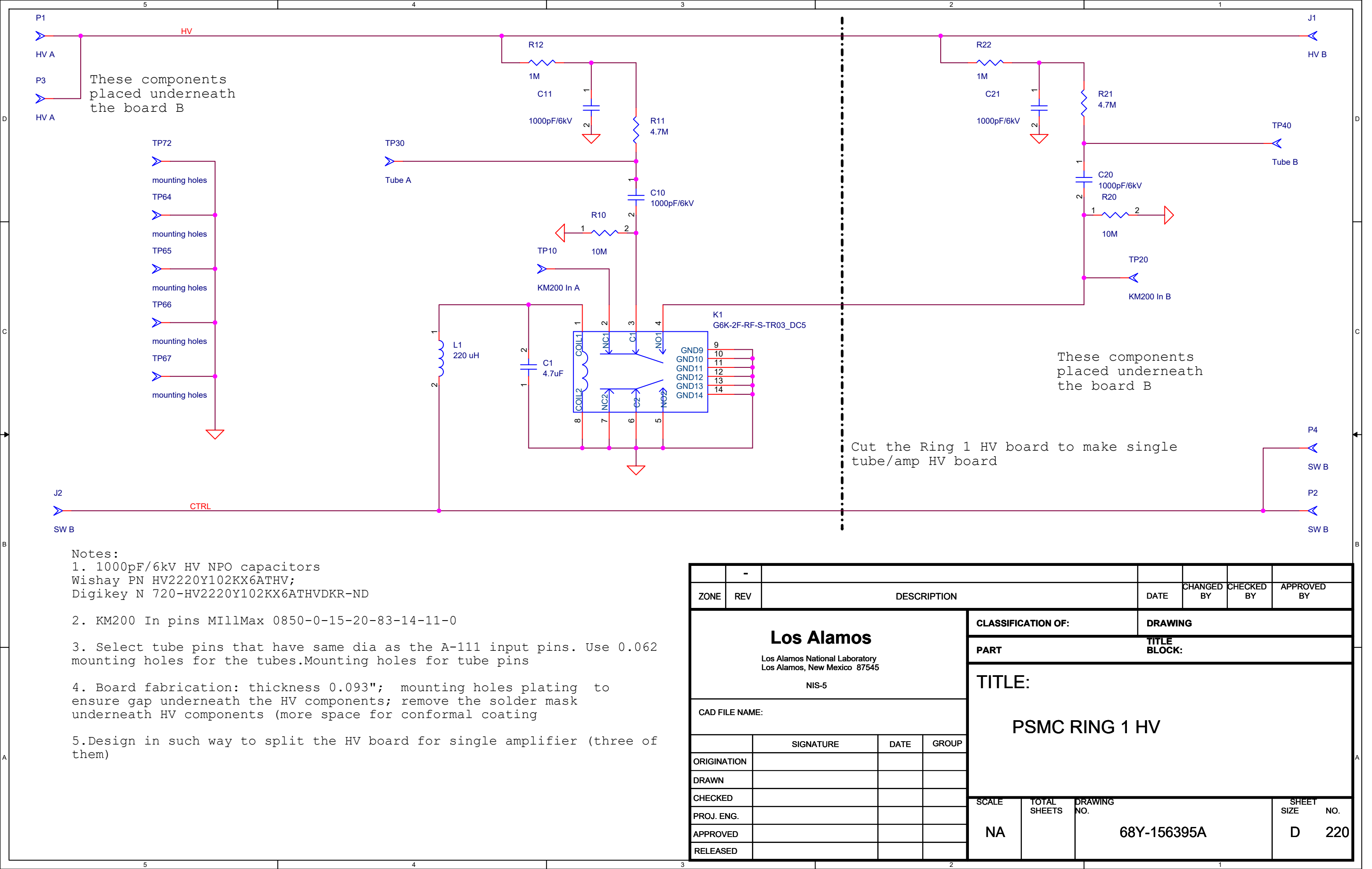
KM200 in PSMC Assembly BOM

Item #	Description	Manufacturer	Part Number	Qty
1	Discriminator Board	LANL NEN-1	68Y-156302	1
2	Preamp Board	LANL NEN-1	68Y-156382	1
3	2-56 Pan Head 1/4"	McMaster Carr	91772A077	4
4	3/16 Hex x 7/32 length standoffs	McMaster Carr	4500T-256-AL	4
5	3/16 Hex x 3/16 length standoffs	McMaster Carr	4500-256-AL	4

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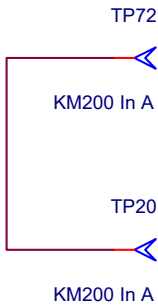
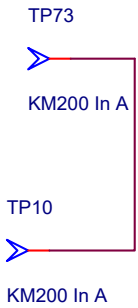
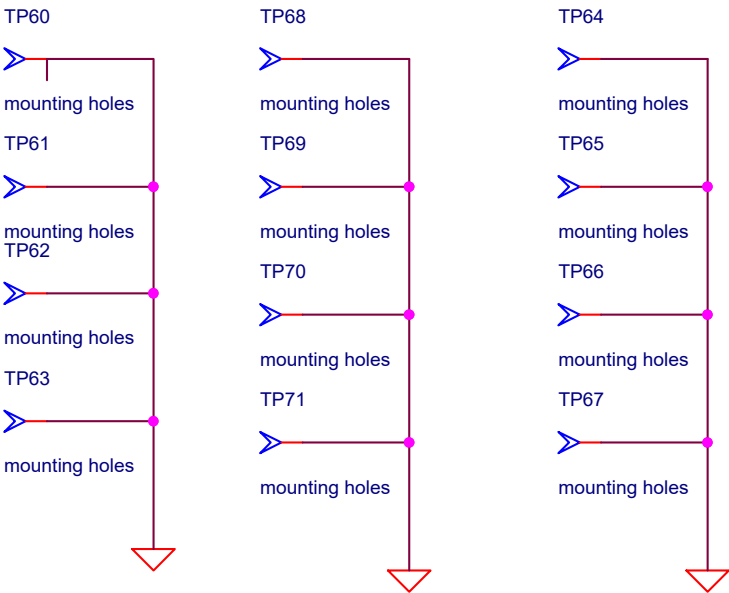


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LOS ALAMOS, NEW MEXICO 87545			KM200 Layout			
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PROJ. ENGR.	NA	NA	NA	SCALE TOTAL SHEETS DRAWING NO. SEE SHEET NO.		
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RELEASED	NA	NA	NA			



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CAD FILE NAME:									
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DRAWN									
CHECKED				SCALETOTAL SHEETSDRAWING NO.SHEET SIZE NO.					
PROJ. ENG.									
APPROVED									
RELEASED				NA		68Y-156395A	D	220	

These components
placed underneath
the board B

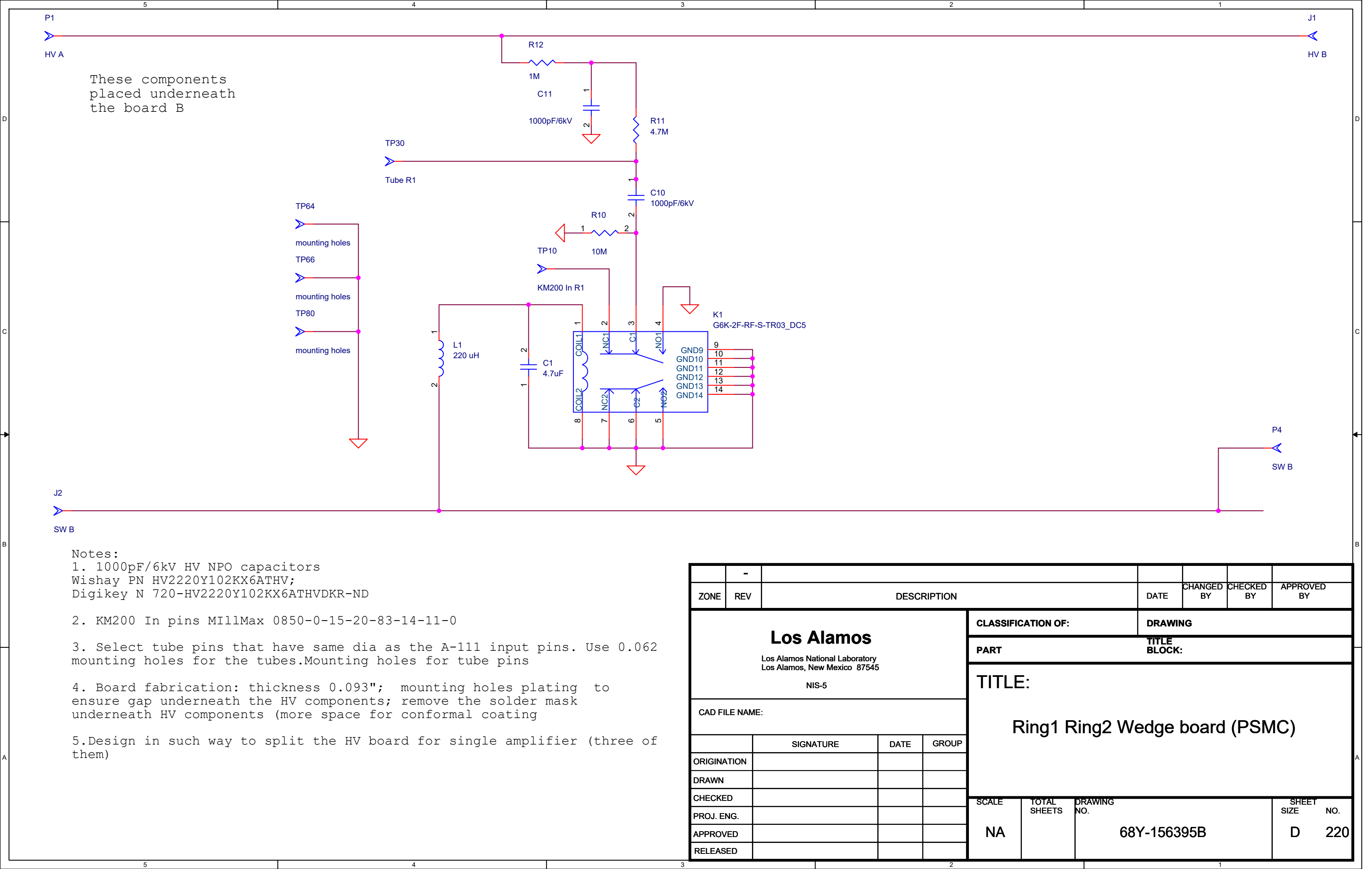


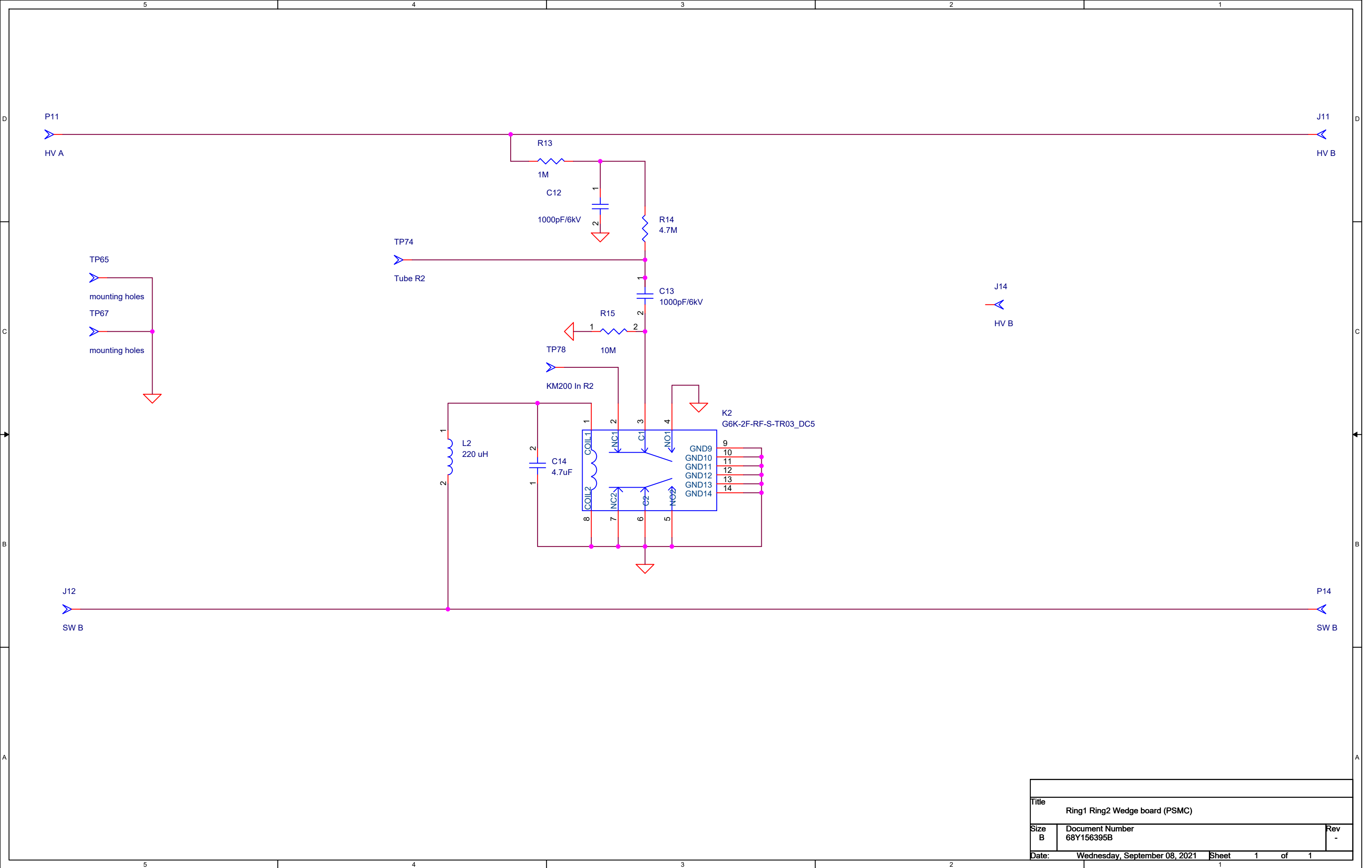
These components
placed underneath
the board B

Cut the Ring 1 HV board to make single
tube/amp HV board

- Notes:
- 1. 1000pF/6kV HV NPO capacitors
Wishay PN HV2220Y102KX6ATHV;
Digikey N 720-HV2220Y102KX6ATHVDKR-ND
 - 2. KM200 In pins MillMax 0850-0-15-20-83-14-11-0
 - 3. Select tube pins that have same dia as the A-111 input pins. Use 0.062 mounting holes for the tubes.Mounting holes for tube pins
 - 4. Board fabrication: thickness 0.093"; mounting holes plating to ensure gap underneath the HV components; remove the solder mask underneath HV components (more space for conformal coating
 - 5.Design in such way to split the HV board for single amplifier (three of them)

	-										
ZONE	REV	DESCRIPTION				DATE	CHANGED BY	CHECKED BY	APPROVED BY		
<div>Los Alamos</div> <div>Los Alamos National Laboratory Los Alamos, New Mexico 87545</div> <div>NIS-5</div>						CLASSIFICATION OF:		DRAWING			
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SCALE	TOTAL SHEETS	DRAWING NO.			SHEET SIZE	NO.					
NA		68Y-156395A			D	220					





Title		
Ring1 Ring2 Wedge board (PSMC)		
Size	Document Number	Rev
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Date:	Wednesday, September 08, 2021	Sheet 1 of 1

Notes:

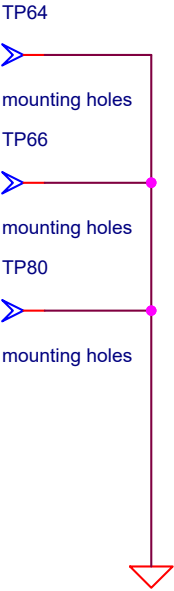
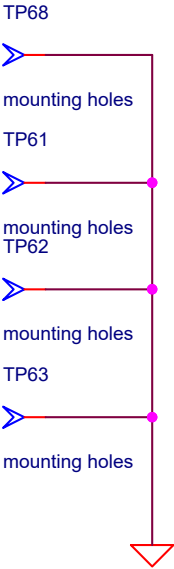
1. 1000pF/6kV HV NPO capacitors
Wishay PN HV2220Y102KX6ATHV;
Digikey N 720-HV2220Y102KX6ATHVDKR-ND

2. KM200 In pins MillMax 0850-0-15-20-83-14-11-0

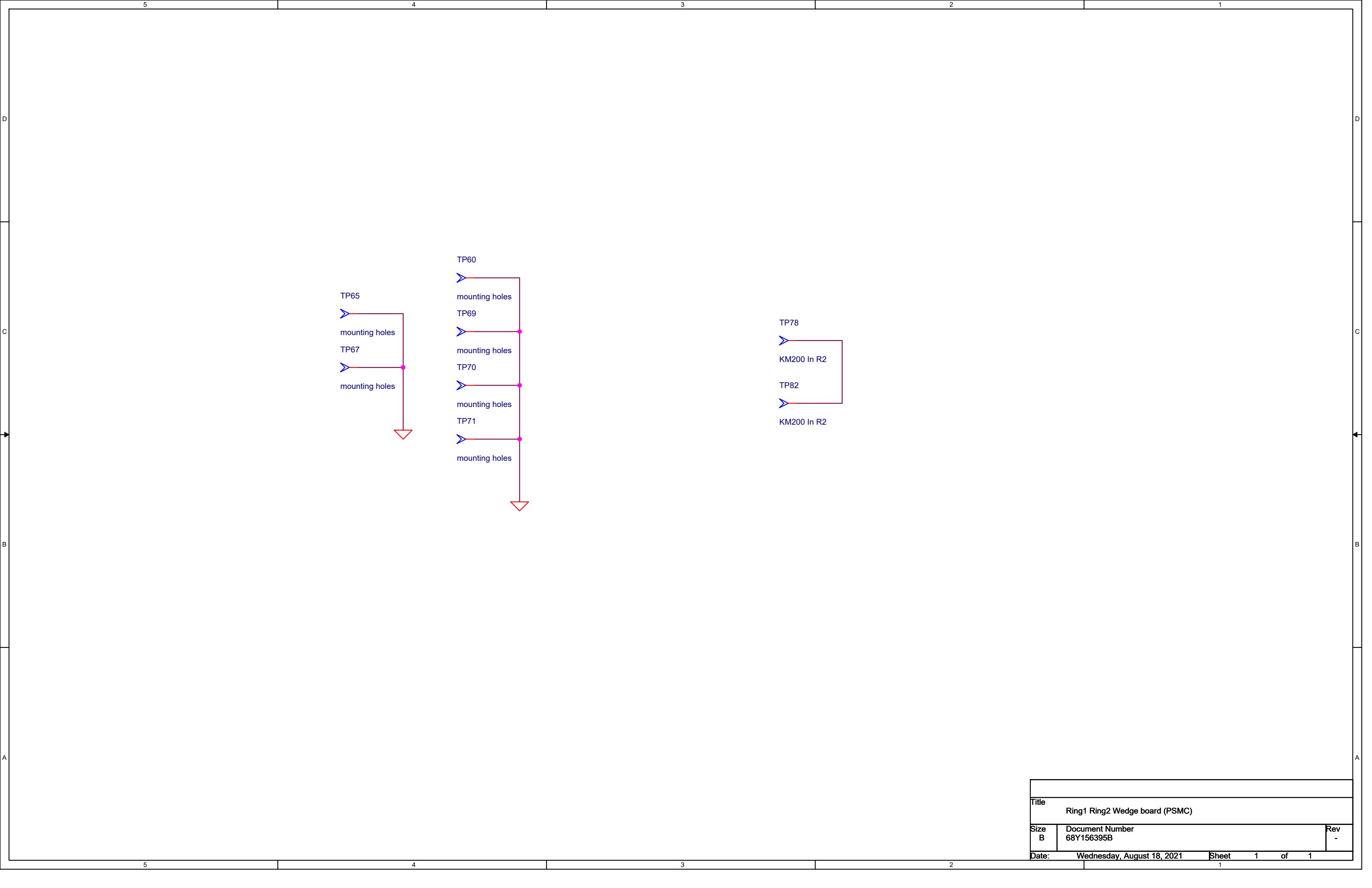
3. Select tube pins that have same dia as the A-111 input pins. Use 0.062 mounting holes for the tubes.Mounting holes for tube pins

4. Board fabrication: thickness 0.093"; mounting holes plating to ensure gap underneath the HV components; remove the solder mask underneath HV components (more space for conformal coating

5.Design in such way to split the HV board for single amplifier (three of them)

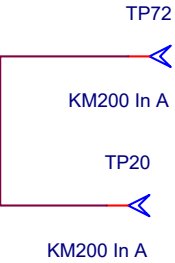
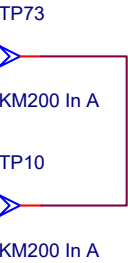
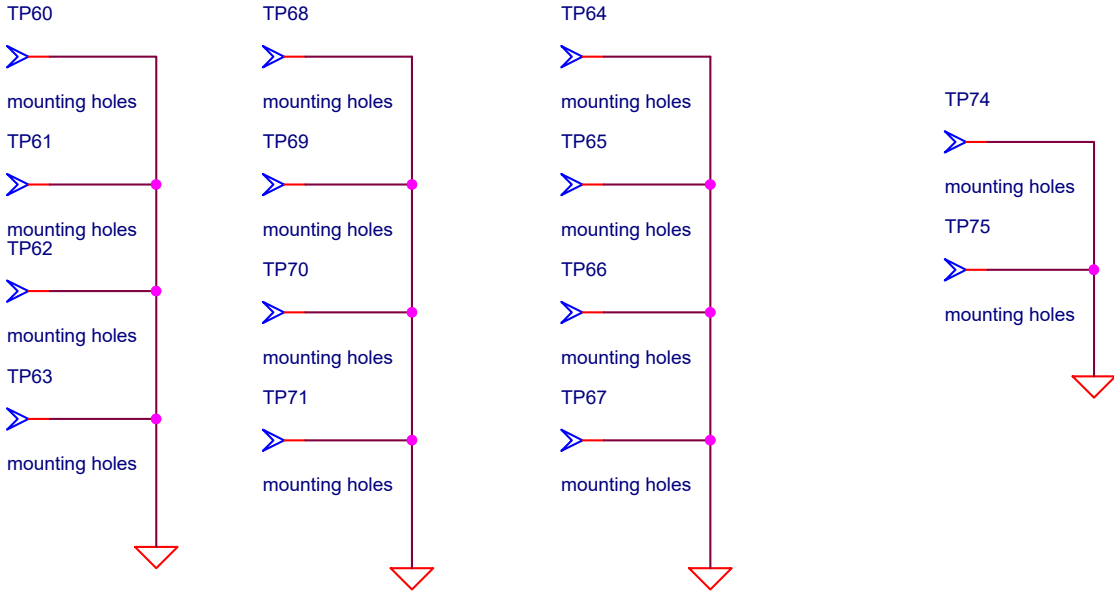


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						PART				TITLE BLOCK:	
						TITLE: Ring1 Ring2 Wedge board (PSMC) SHIELD					
CAD FILE NAME:		SCALE		TOTAL SHEETS	DRAWING NO.		SHEET SIZE	NO.			
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DRAWN											
CHECKED											
PROJ. ENG.											
APPROVED											
RELEASED											



Title		
Ring1 Ring2 Wedge board (PSMC)		
Size B	Document Number 68Y156395B	Rev -
Date:	Wednesday, August 18, 2021	Sheet 1 of 1

These components
placed underneath
the board B

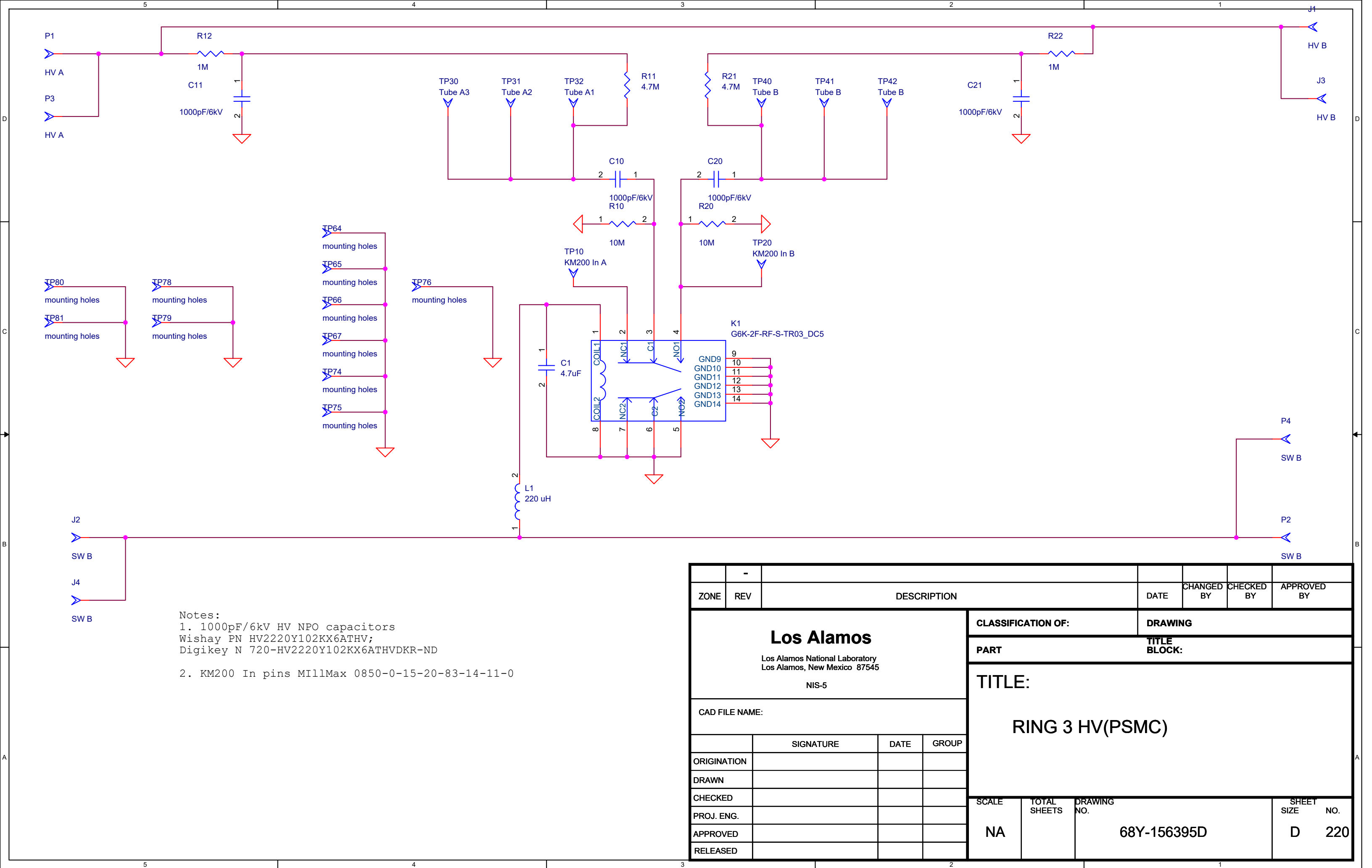


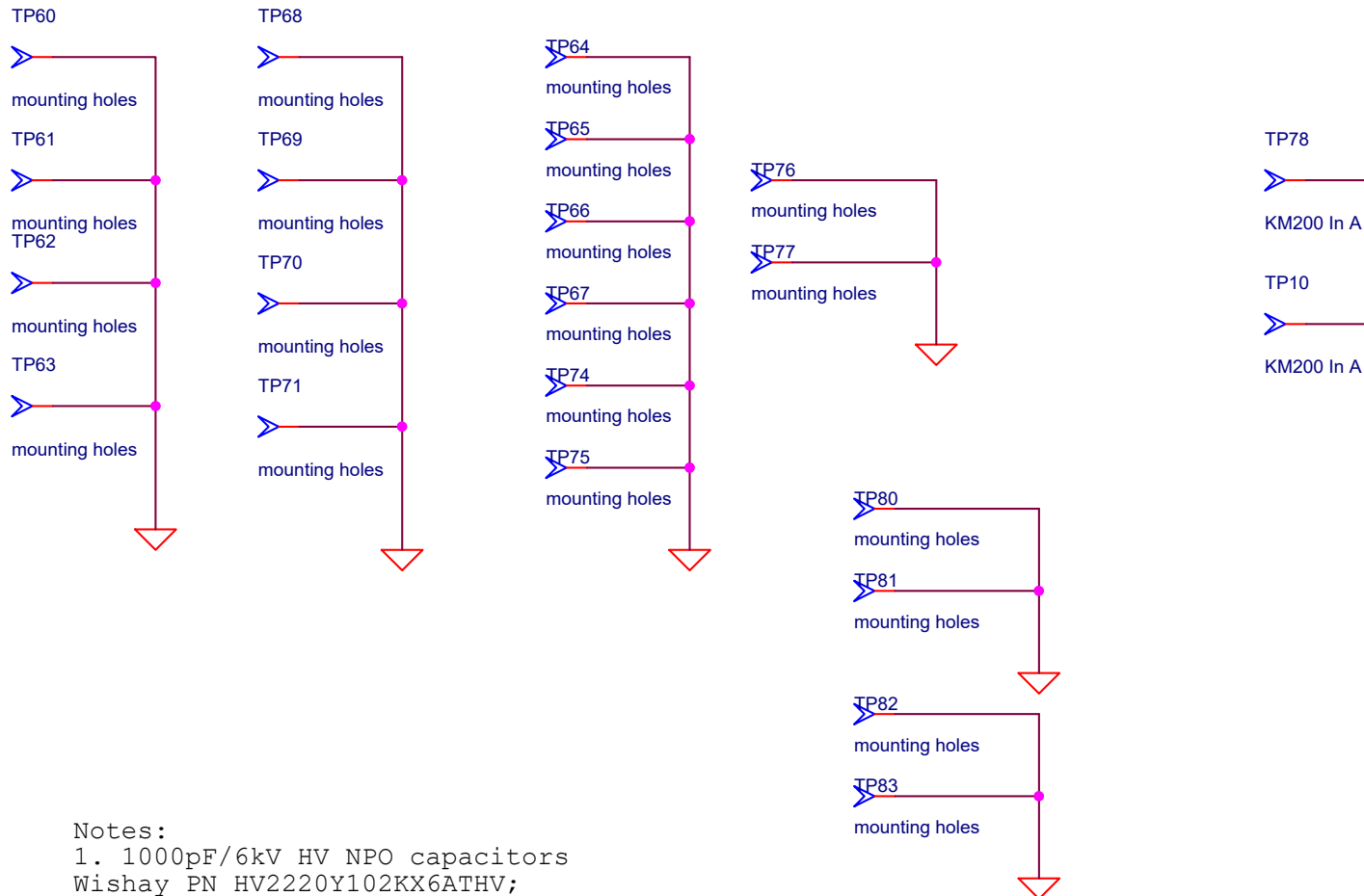
These components
placed underneath
the board B

Cut the Ring 1 HV board to make single
tube/amp HV board

- Notes:
- 1. 1000pF/6kV HV NPO capacitors
Wishay PN HV2220Y102KX6ATHV;
Digikey N 720-HV2220Y102KX6ATHVDKR-ND
 - 2. KM200 In pins MI11Max 0850-0-15-20-83-14-11-0
 - 3. Design in such way to split the HV board for
single amplifier (three of them)

	-										
ZONE	REV	DESCRIPTION				DATE	CHANGED BY	CHECKED BY	APPROVED BY		
<div>Los Alamos</div> <div>Los Alamos National Laboratory Los Alamos, New Mexico 87545</div> <div>NIS-5</div>					CLASSIFICATION OF:		DRAWING				
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						Date: Friday, August 13, 2021					
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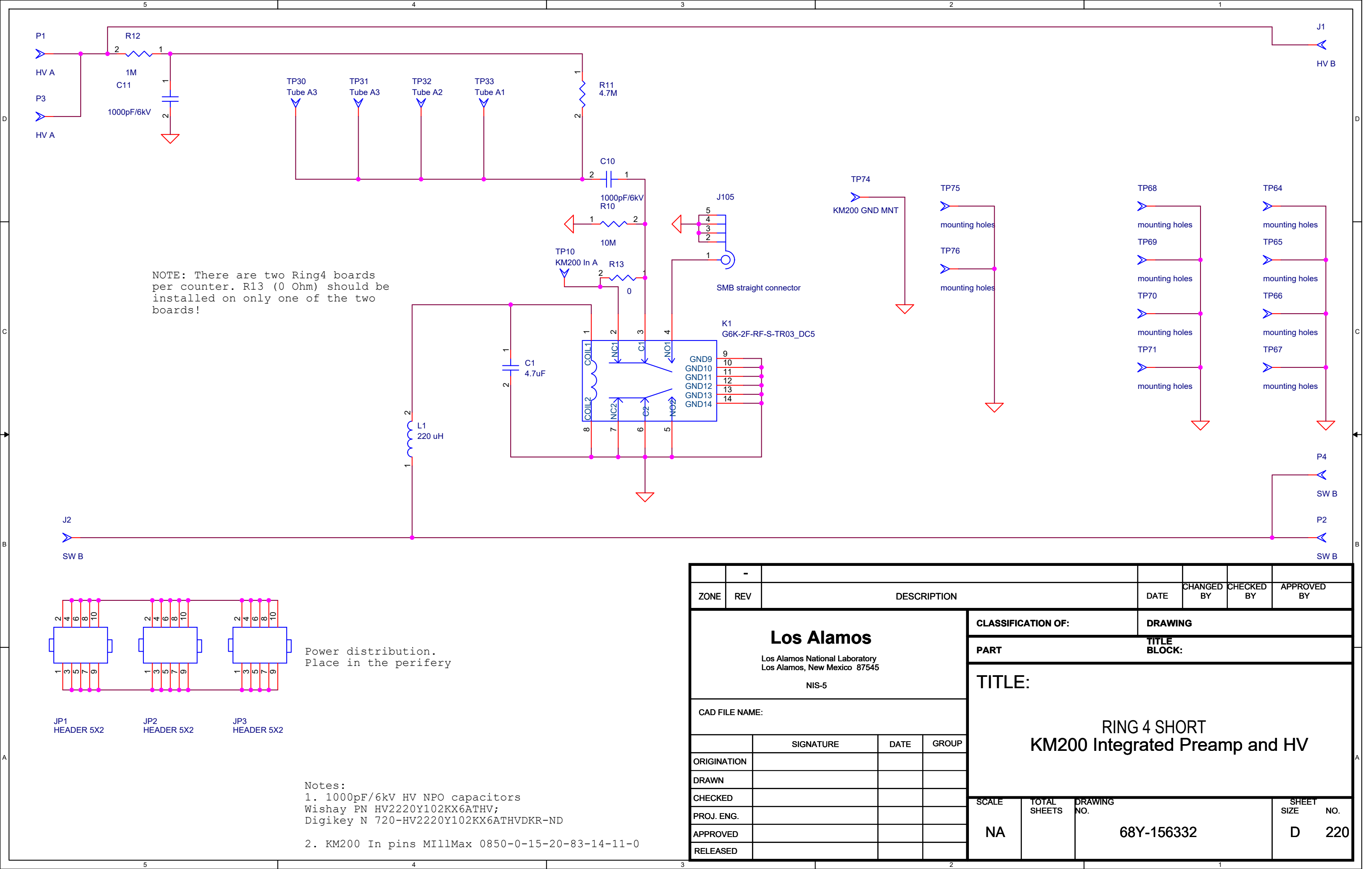


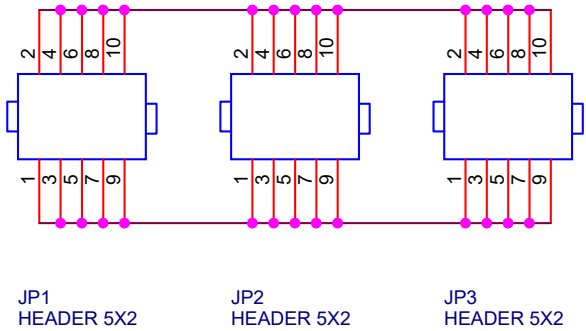


Notes:
1. 1000pF/6kV HV NPO capacitors
Wishay PN HV2220Y102KX6ATHV;
Digikey N 720-HV2220Y102KX6ATHVDKR-ND

2. KM200 In pins MIllMax 0850-0-15-20-83-14-11-0

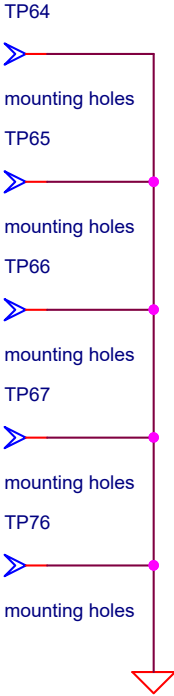
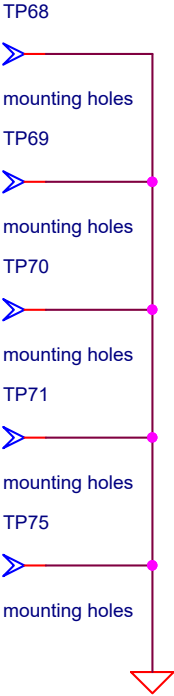
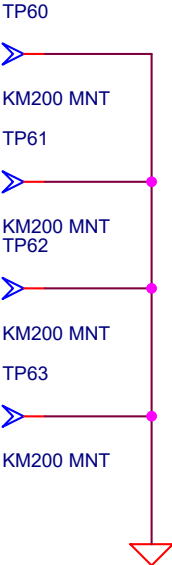
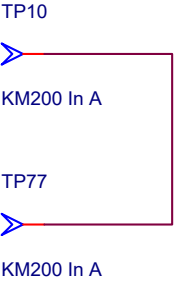
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CAD FILE NAME:					SCALE	TOTAL SHEETS	DRAWING NO.		SHEET SIZE NO.
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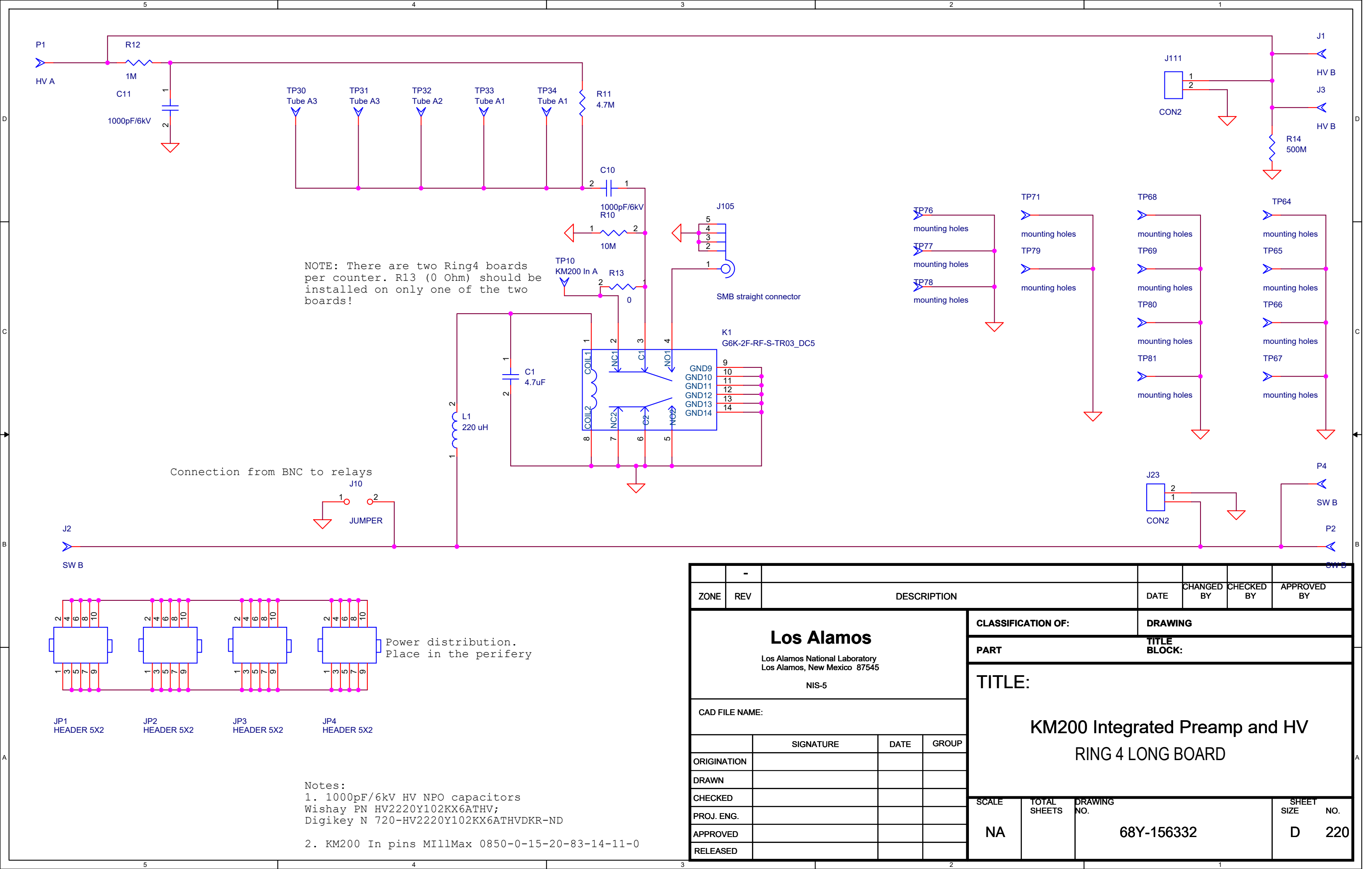


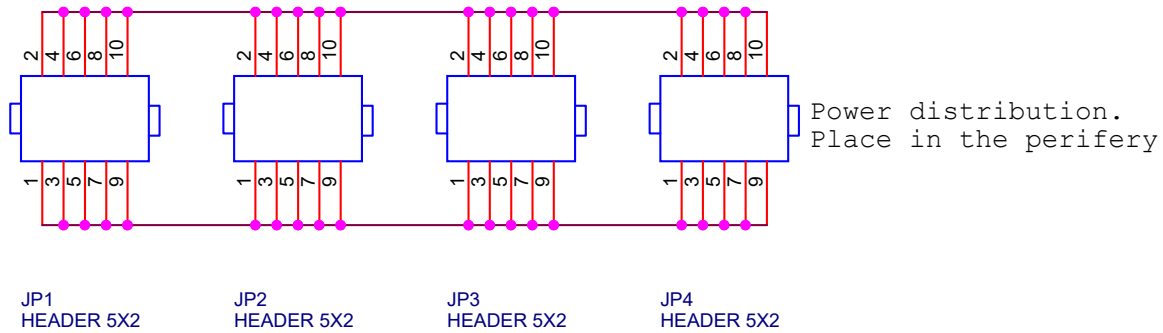
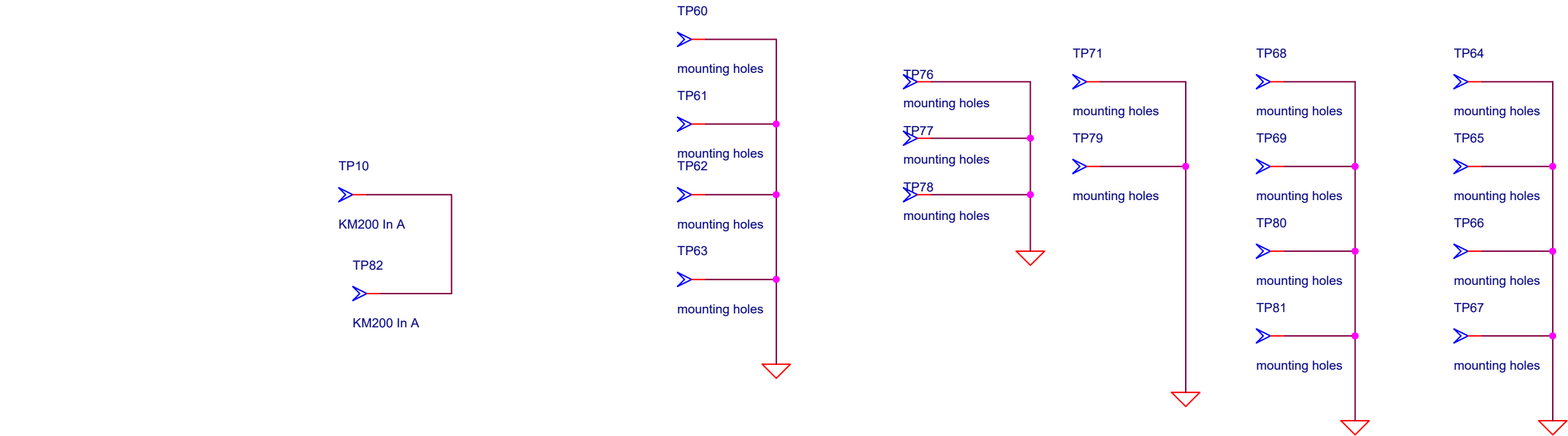
Power distribution.
Place in the periphery

- Notes:
- 1. 1000pF/6kV HV NPO capacitors
Wishay PN HV2220Y102KX6ATHV;
Digikey N 720-HV2220Y102KX6ATHVDKR-ND
 - 2. KM200 In pins MIllMax 0850-0-15-20-83-14-11-0



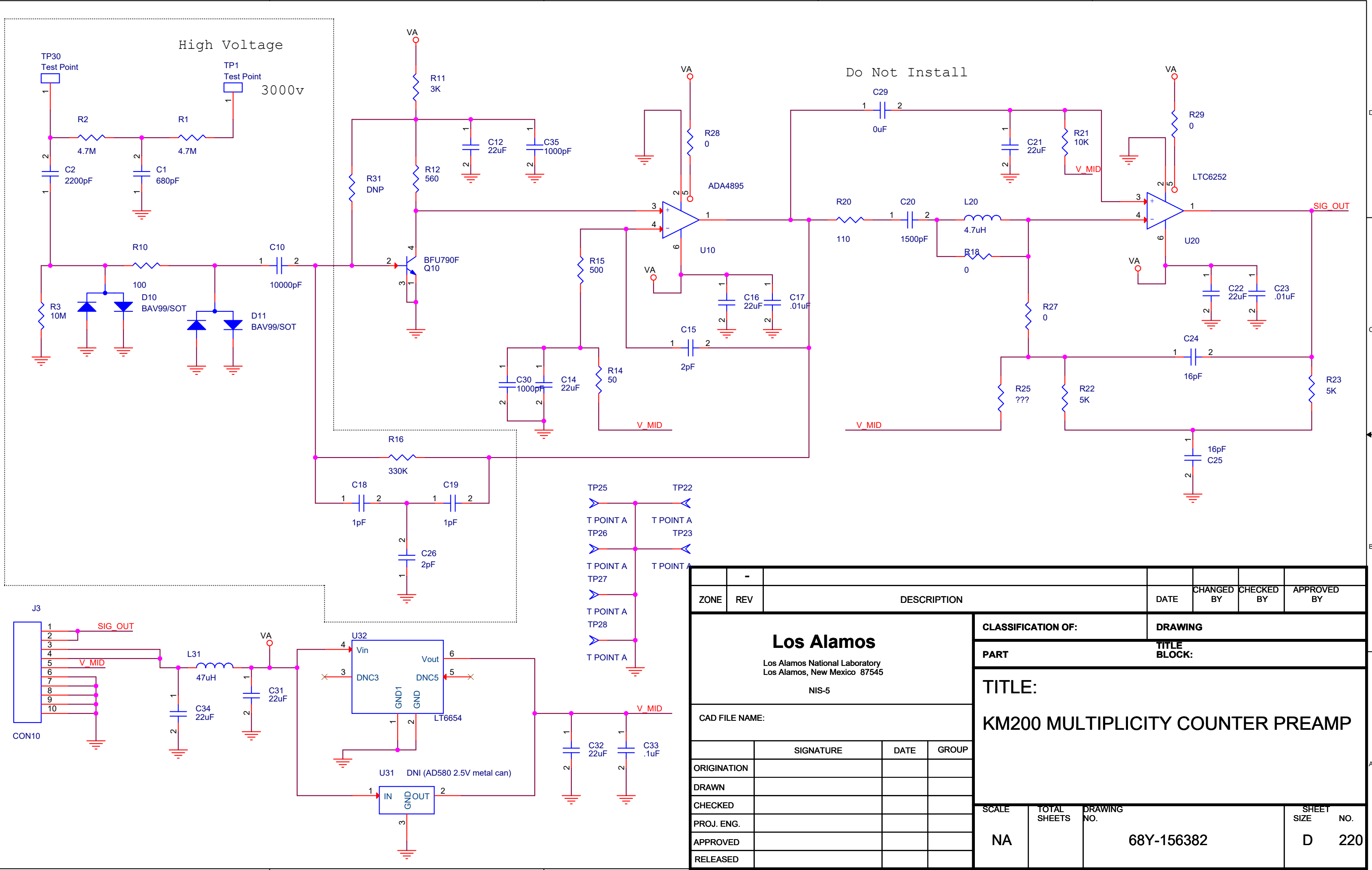
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Los Alamos Los Alamos National Laboratory Los Alamos, New Mexico 87545 NIS-5				CLASSIFICATION OF:		DRAWING				
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CAD FILE NAME:				TITLE: SHIELD BOARD RING 4 SHORT						
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DRAWN										
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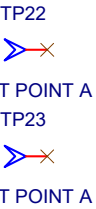


Notes:
1. 1000pF/6kV HV NPO capacitors
Wishay PN HV2220Y102KX6ATHV;
Digikey N 720-HV2220Y102KX6ATHVDKR-ND
2. KM200 In pins MI11Max 0850-0-15-20-83-14-11-0

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			PART					
CAD FILE NAME:			TITLE: PSMC RING 4 LONG SHIELD BOARD					
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DRAWN								
CHECKED								
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APPROVED				NA		68Y-156395F	D	220
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PROJ. ENG.										
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ORIGINATION											
DRAWN											
CHECKED											
PROJ. ENG.											
APPROVED											
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